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ABSTRACT

Research investigated: 1) the relation between user anxiety and the utilization of computer facilities, 2) the effect of "hands on" computer experience on anxiety levels of operators, and 3) the effect of prior computer exposure on anxiety levels. Male volunteer college students in good health were assigned to three groups, depending on their having extensive, little, or no computer experience. All subjects completed a non-projective anxiety measure, received a lecture on computer utilization, and worked through a computer task. Systolic and diastolic blood pressure, heart rate, and electro-dermal response measured anxiety. Results indicated that regardless of previous exposure, subjects experienced anxiety, as reflected by physiological changes, during the initial part of the computer task, but that continued "hands on" manipulation reduced anxiety below the pre-exposure level. Additional research should determine how to control extraneous anxiety-producing variables, investigate the effects of a variety of anxiety-reduction techniques, and examine the cause-effect relationship between anxiety and computer terminal operating efficiency. (PB)

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THE EFFECTS OF PRIOR COMPUTER EXPOSURE ON MAN-MACHINE COMPUTER ANXIETY

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Since the advent of computers there is an increasing impetus toward facilitating the use of computer time. The use of computer facilities by lay personnel, which frees the computer scientist for more innovative activity, is increasing in many computer centers throughout the country. It is therefore important to investigate new techniques to reduce instruction time while maintaining minimum performance levels. Aside from the basic logistics of computer terminal operations, other variables may effect the efficiency of individuals using these systems. Some scholars suggest that excessive anxiety levels toward a given task detrimentally effect performance on that task (McCroskey, 1970). The purpose of this investigation is to determine the relationship between user anxiety and the utilization of computer facilities. An obvious extension and long range goal of this preliminary investigation is the determination of some means of reducing the problem (if it exists) and thus facilitate computer instructional techniques. Computer facilities, even though easily accessible, have not been used to their potential by public and private agencies.

The following general research questions were formulated to provide structure to the design and data analysis:

(1) What is the effect of "hands on" computer experience on the anxiety levels of operators?

(2) If an anxiety function occurs, what is the effect of prior computer exposure on that function?

This report attempts to answer these general questions. A basis for implementable suggestions will be formed in conjunction with implications for further research.

Design

Subjects

Male volunteer subjects were selected and assigned into three categories: (1) no previous computer exposure, (2) minimal computer exposure -- 5 to 10 applications, and (3) advance computer exposure -- more than 10 applications. All subjects were required to meet three physical criteria: (1) no previous documented cardiovascular pathology, (2) no known hypertensive difficulties, and (3) general good health. Subjects were selected from a variety of University of Oklahoma Summer Session classes. Each subject was paid ten dollars following participation in approximately four hours of experimental manipulation. Initially twenty-two subjects were selected. However, attrition did occur. This resulted in six subjects within each of the primary criteria conditions. No speculation regarding the attrition has been made at this time.

Procedures

Following selection of subjects, a two hour training session for all subjects was conducted. During this session, subjects completed personal data forms and a non-projective anxiety measure. A lecture concerned with the utilization of the computer program was then administered.

The information retrieval system used in this investigation was the GIPSY System (General Information Processing System), developed at the University of Oklahoma. The retrieval language (Questron) is a non-procedural language consisting of commands to control the program modules and the parameters which initiate specific operations (Addison, Shields, and Sweeney, 1969). The data base used in this study was a selection of 5000 abstracts from the 35,000 abstracts within the WRSIC (Water Resources Scientific Information Center) compilation. The Datel-30 terminal was used by all subjects.

Computer anxiety was operationally defined through the utilization of four well established physiologic measures (Best and Taylor, 1961). Those variables and the measurement techniques are as follows:

(1) Systolic Blood Pressure -- standard indirect measurement.

(2) Diastolic Blood Pressure -- standard indirect measurement.

(3) Heart Rate -- 30 second count.

(4) Electro Dermal Response (EDR) -- mean spontaneous response.

On an individual basis, the subject's physiological reactions were monitored through thirteen time periods listed in Table 1 (See Appendix A). During the first ninety seconds of each period (with the exception of T_1, T_5, T_7, and T_{10}) data was collected on all four physiologic variables. Random ordering of subjects was made.

During T_1, data was collected several times on a trial basis to allow subjects to become accustomed to the movements involved in data collection. During T_3 subjects were reviewed as to the procedures for manipulating GIPSY and were given the following statement to search: "Please locate all abstracts pertaining to phosphate pollution in the southwestern region of the United States." An operator trained in GIPSY procedures was available to provide guidance when requested by the subject.

Analysis of the Data

Data collected on the four physiological variables were considered to be of interval level. Raw scores were assumed to reflect an individual's physiological resistance rate. Therefore, the decision was made to utilize change scores. On this basis, change scores between periods of relaxation (T_1 and T_{12}) and periods of stress (T_2, T_6, and T_{13}) were considered as raw scores on each of the variables for between-groups analysis.

In order to best respond to the research questions previously formulated, the periods considered for this analysis were T_1, T_2, T_6, and T_{13}. Due to the inherent dependency of any one datum upon the preceding datum when using physiologic variables, the t_{corr} (t-test for Repeated Measures Design) was used as the statistic for within-group analysis (Runyon and Haber, 1971). The Analysis of Variance for independent measures was used for between-group analysis.

In an attempt to respond to the research questions the following hypotheses were generated:

(1) A significant difference will be observed between the three groups of subjects during the T_1-T_6 progression.

(2) A significant difference will be observed between the three groups of subjects during the T_6-T_{13} progression.

(3) A significant difference will be observed between the three groups of subjects during the T_2-T_{13} progression.

(4) T_6 datum will be significantly higher than T_1 datum.

(5) T_6 datum will be significantly higher than T_{13} datum.

(6) T_2 datum will be significantly higher than T_{13} datum.

In order to test the first three hypotheses an analysis of variance was conducted between groups on the change scores for each respective set of time periods. The results are indicated in Table 2 (See Appendix B). The .05 level of significance was established.

No significant differences were observed between groups on any of the physiological variables during any of the time sets; therefore, the null of hypotheses 1, 2, and 3 could not be rejected.

In order to test hypotheses 4, 5, and 6, a t_{corr} was conducted for each group and for the entire sample over each of the time sets and each of the physiological variables. Tables 3, 4, and 5 (See Appendices C, D, and E respectively) indicate the results of statistical analysis. The .05 level of significance

(One-tailed) was established. Due to the consistency of significant increases in all four physiological variables, research hypotheses 4, 5, and 6 were accepted. Although the consistency was not as strong in the T_2-T_{13} case, enough significant decreases across variables were observed to consider the acceptance of research hypothesis 6.

Discussion

The most obvious conclusion from the present study was that exposure to computer terminal use is initially an anxiety producing situation that reflects itself in changes in basic physiologic activity. In addition, continued exposure, in conjunction with terminal manipulation, reduces anxiety below the pre-exposure level.

Anxiety apparently was present regardless of prior computer exposure. The lack of relationship between previous computer exposure and the amount of physiologic change may be in part, a function of the program utilized. Intuitively, individuals who use the computer often would not experience anxiety when asked to complete a task. However, the results of this study seem not to confirm such an intuition. It is possible, however, that a portion of the anxiety indicated in advanced computer experience subjects may be due to the methodological demands of the experiment. The utilization of an unfamiliar program may have contributed to the increased anxiety of the advanced subjects beyond that level of anxiety produced by computer manipulation. This effect may account for the lack of significant differences in the prior exposure condition.

The most impressive changes were observed during the T_6-T_{13} period of the information retrieval sequence. This suggests that the apparent anxiety produced within each group was a function of some inherent fear of the mechanics of computer terminal operation.

Results indicated that a significant decrease in cognitive anxiety (T_2-T_{13}) did occur as a function of utilization of the computer terminal. This suggests that perhaps more emphasis on the physical manipulation of the computer terminal may reduce anxiety toward the task. This study did not, however, compare efficiency of performance with anxiety level as measured physiologically but rather assumed an inverse relationship between the two.

In observing the changes in the various physiologic measures used, it is apparent and not surprising in terms of previous research using physiologic measures, that any single measure is insufficient to demonstrate the group changes caused by the anxiety. Some individuals, for example, showed an increase in blood pressure with no increase in heart rate and vice versa. The greatest inconsistencies were noticed in the electro-dermal response changes which were known to have questionable reliability as a general measure of anxiety for short durations of sampling.

Data was also collected on a non-projective measure. An instrument felt to reflect specifically computer communication anxiety was developed. The basis for development was the Personal Report of Communication Apprehension for College Students (McCroskey, 1970). Data analysis concerned with both the non-projective instrument and the physiologic operationalizations is continuing at this time. The factor analysis technique is being applied to the non-projective instrument. Multiple and particl correlation and regression analysis is being applied to the physiologic data in an effort to establish the relationships of the four physiologic variables. Through such analysis, the information gain of the different variables, used singularly or in combination, may be obtained.

Future studies should emphasize the control of extraneous anxiety producing variables such as data collection techniques and program familiarity. The effects of a variety of anxiety reduction techniques should be investigated, i.e., terminal

manipulation training, lecture techniques, systematic desensitization techniques, etc. Investigation of a cause-effect relationship between anxiety and computer terminal operation effectiveness should be considered a high priority research project.

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APPENDICES

APPENDIX A

Table 1

Time Periods

T_1 - Base line -- relaxation and acclimation period.

T_2 - Subject's response to verbal question, "Considering your past experience and knowledge tell us your reaction to working with computers."

T_3 - Review session.

T_4 - Subject's formulated research strategy.

T_5 - Machine preparation (no data collection).

T_6 - First ninety seconds on Datel 30.

T_7 - Machine time -- response to initial input (no data collection).

T_8 - Waiting time for first subset.

T_9 - Machine time and further subject input.

T_{10} - Waiting time for last feedback (no data collection).

T_{11} - Subject observing last feedback.

T_{12} - Relaxation period.

T_{13} - Subject response to T_2 verbal question.

APPENDIX B

Table 2

ANOVA--Between Groups

Time Period	Physiological Variable	F Value	df
T_1-T_6	SBP[1]	0.57	2/15
T_1-T_6	DBP[2]	0.26	2/15
T_1-T_6	HR[3]	0.61	2/15
T_1-T_6	EDR[4]	2.64	2/12
T_6-T_{13}	SBP	0.27	2/15
T_6-T_{13}	DBP	0.34	2/15
T_6-T_{13}	HR	1.79	2/15
T_6-T_{13}	EDR	0.84	2/12
T_2-T_{13}	SBP	0.73	2/15
T_2-T_{13}	DBP	0.30	2/15
T_2-T_{13}	HR	1.21	2/15
T_2-T_{13}	EDR	1.49	2/12

$P < .05$ (df=2/15, F value=3.68)
$P < .05$ (df=2/12, F value=3.88)

[1]SBP - Systolic Blood Pressure
[2]DBP - Diastolic Blood Pressure
[3]HR - Heart Rate
[4]EDR - Electro Dermal Response

APPENDIX C

Table 3

t_{corr}, T_1-T_6

Variable	Group	t_{corr} Value	df	$\overline{X}$ Change
SBP	Grp 1	2.666*	5	12.00
	2	1.745	5	6.33
	3	1.113	5	6.67
	Sample	3.107*	17	8.33
DBP	Grp 1	2.470*	5	9.67
	2	3.922*	5	9.00
	3	2.495*	5	12.67
	Sample	4.821*	17	10.44
HR	Grp 1	5.000*	5	10.00
	2	3.478*	5	10.00
	3	2.712*	5	6.67
	Sample	3.684*	17	8.89
EDR	Grp 1	0.000	4	0.00
	2	0.547	4	0.80
	3	2.331*	4	2.40
	Sample	1.604	14	1.07

*p <.05

APPENDIX D

Table 4

t_{corr}, T_6-T_{13}

Variable	Group	t_{corr} Value	df	$\bar{X}$ Change
SBP	Grp 1	4.936*	5	-12.33
	2	5.546*	5	-11.33
	3	2.360*	5	- 9.33
	Sample	3.903*	17	-11.00
DBP	Grp 1	4.110*	5	- 8.33
	2	3.800*	5	- 6.33
	3	1.847	5	-10.33
	Sample	4.219*	17	- 8.83
HR	Grp 1	4.842*	5	-12.67
	2	3.674*	5	-12.00
	3	2.666*	5	- 5.00
	Sample	6.173*	17	-10.22
EDR	Grp 1	1.970	4	- 1.60
	2	2 333*	4	- 1.40
	3	3.474*	4	- 2.60
	Sample	4.525*	14	- 1.87

*p $<$.05

APPENDIX E

Table 5

t_{corr}, T_2-T_{13}

Variable	Group	t_{corr} Value	df	$\bar{X}$ Change
SBP	Grp 1	2.324*	5	-6.00
	2	3.501*	5	-6.00
	3	0.412	5	1.167
	Sample	2.331*	17	-3.61
DBP	Grp 1	0.681	5	1.67
	2	1.291	5	4.00
	3	2.712*	5	3.33
	Sample	2.280*	17	3.00
HR	Grp 1	1.348	5	-2.67
	2	2.485*	5	-7.00
	3	0.349	5	0.67
	Sample	2.071*	17	-3.00
EDR	Grp 1	5.489*	4	-3.20
	2	2.391*	4	-2.00
	3	2.667*	4	-1.60
	Sample	5.560*	14	-2.27

*$p < .05$